AMERICAN JOURNAL OF OPTOMETRY

VOL. 9 AUGUST, 1932 NO. 8

DIATHERMY AND HIGH-FREQUENCY IN OPTOMETRIC PRACTICE*

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The subject which I am to talk about is one which is considered appropriate and of interest to an optometric audience, because many men I am sure would like to hear what is being done with diathermy and high-frequency in optometric practice. After reading many articles in the *American Journal of Optometry* by Kurtz, and attending his lecture in December, 1930 in Boston, I decided to equip myself with the necessary apparatus and text books for the purpose of using it in my practice. Besides Kurtz's lecture course, a complete set of notes which I have studied, and his book [1] recently published, I have followed Granger's techniques in the work and have been guided by Hollander and Cottle in using diathermy and high-frequency.

The question has been asked, in your opinion do you believe that diathermy and high-frequency are essential to a successful optometric practice? To this I answer in the negative. It does, however, add to some degree, to the success of an optometric practice.

Diathermy and high-frequency is only useful to the optometrist, with few exceptions, as an adjunct in treating those cases which we have been heretofore treating only with prisms and motility apparatus. So I might say, that unless you are fairly well equipped with those instruments necessary for giving orthoptic training—and no one instrument will answer for all cases—then you are not ready to incorporate diathermy, high-frequency, and other physio-therapy in your practice.

The question has been frequently discussed: have we the right under the existing laws in the many states, to use this agency in our optometric practice? I am in agreement with Kurtz on this point. He

*An abridgement of material presented before the Southeastern Congress of Optometry, April, 1931.

says: "There is no profession in existence today which is strictly limited to its own field and is not over-lapping to a certain extent some other field." "Physical therapy is not specifically authorized in the optometry laws and neither is it specifically prohibited."—So if we use this agency in our practice purely in an optometric manner, guarding against the temptation of using it for conditions that we are not legally authorized, and not properly instructed to treat, then it seems to me, that so far as the legal question is concerned we have perfect right to make use of diathermy, high-frequency, and all other physical agents so long as we confine its use to treating regular optometric cases.

Judge Wilton[2] in making his favorable decision to optometry in the State of Pennsylvania made the following analogy: "We cannot regard the fact that the work done by the eye-specialist-physician and that done by the optometrist, to a certain limited extent, overlap each other, constitutes the optometrist a practitioner of medicine. Such work on the part of the optometrist was done by him, perhaps and probably, long before the eye-specialist-physician had either the knowledge or the skill to do the work which is now being done by both the physicians and the optometrists. It is to be supposed that reputable physicians, as a part of their practice, at times use electricity and massage as a part of their method of treating diseases. Would it be fair application of the statutes in question to say that every massuer and every electrician was practicing medicine because he applied massage or used electrical apparatus in the same manner that the physicians do or have done?"

So simply because diathermy, high-frequency, and ultra-violet are used by some medical men, they do not necessarily become a part of medicine. I have no doubt, but that at some future time medicine will attempt to relegate this therapy to their profession exclusively. After all, what is optometry other than making use of physical agents in the practice? A lens is a physical agent, and so is a prism.

These findings by research workers lead us to believe that the force of electric energy is important in animal economy. Physiological relations are not as well understood, but enough is known to cause us to appreciate the therapeutic value of electricity.

Grover[3] claims "that from an electro-physical standpoint the human body is the most delicate, intricate, and wonderful apparatus of which we have conception. Within the structure are contained electric generators, convertors, vibrators, rheostats, condensors, resonators, inductances, transformers, conductors, insulators, collecting and dispersing electrodes. It develops electro-motor force producing volts, amperes and watts. The skin presents a resistance of thousands of ohms. The body is full of primary cells connected in series and in multiples and develops continuous, alternating, sinusoidal, static, inductive, and oscillatory currents. Its diathermic apparatus converts mechanical energy into heat. The body as a whole exhibits a polarity which is usually positive, but may be changed to negative by surrounding objects, etc. It receives electrical

charges and disperses them. It has electric circuits opened and closed. It not only possesses every device known to electric science, but many details of construction and activity which we do not understand."

Is diathermy and high-frequency dangerous to use? Bordier, one of the French authorities says: "We must remember that diathermic treatments are painless, devoid of risks to the patient and can be continued as long as desired." This statement should be qualified, I think, by adding: That diathermy in the hands of one who has some knowledge of the principals of electricity, and the proper technique of application of the agency, and knowledge of the kind of cases to treat and not to treat, is devoid of risks, painless and can be continued as long as the patient shows no indications of it becoming incompatable.

What is diathermy and high-frequency? There are at least ten types or methods of applying electrical energy which are used in electrotherapy. Diathermy and high-frequency are said to be first in importance in ocular treatment. 1. Diathermy. 2. High-frequency. 3. Ultra-violet. 4. Infra-red. 5. Sinusoidal. 6. Galvanic. 7. Faradic. 8. X-ray. 9. Radium and 10. Millikins cosmic rays.

In 1891 Nikola Tesla first suggested the use of that form of electricity which is now called high-frequency. It is an alternating current of 10,000 to 3,000,000 alternations per second, with a voltage and amperage very high, or lower according to the construction of the machine.

The frequency is beyond the point of producing muscular contractions. The commercial alternating current reverses itself completely 120 times per second and is known as a 60 cycle current.

A cycle is made up of two alternations, one positive and one negative alternation.

The time required for the current to make a complete cycle is called a period.

The frequency is the number of complete cycles occurring in one second's time.

The flow of electricity through a conductor possesses attributes and characteristics analogous to those of a stream of water falling from a height or flowing through a pipe. The amount of water flowing through the pipe in a given time and the size and diameter of the stream would depend upon the length, diameter, and resistance of the pipe, this to be taken into consideration with the speed of the stream or the pressure which causes it to flow. The same is equally true of an electrical current. Electricity of a given pressure or potential will create a current of a certain volume or intensity in a current of a given resistance. The electrical units of pressure, volume, and resistance are designated as Volt, Ampere and Ohm.

A Volt is defined as an electrical unit of pressure or potential.

An Ampere is an electrical unit of volume or intensity.

An Ohm is an electrical unit of resistance.

There are three distinct types of high-frequency currents which are produced by different kinds of coils. The current produced by each coil has a separate and distinct characteristic. 1. D'Arsonval. 2. Tesla and 3. Oudin.

High-frequency has no polar and no electrolyte or ionic effects. It has marked thermic, with physical and slight chemical effects. It is a mono-terminal application of heat direct to the outer tissues and has a limited penetrating power.

Diathermy according to Granger and Sampson,[4] gives the following physiological conditions, and promotes the following effects.

"1. The immediate development of an arterial hyperemia, bringing more arterial blood than the normal to the deep seated area.

"2. Sending more venus blood and lymph out of the part between the electrodes, giving tissue drainage.

"3. An increase in the leukocytes and phagocytes, developing a local phagocytosis highly active in the area treated."

Hollander and Cottle [5] says "Diathermy offers an important addition to the management of optic nerve diseases; to vitreous opacities; to cataracts; to some cases of glaucoma."

Granger mentions several kinds of headaches which may be relieved with diathermy and high-frequency.

Kurtz [1] lists many ocular conditions which may be treated with diathermy and high-frequency with successful results. They are as follows:

1. Amblyopia, 2. Asthenopia, 3. Blepharitis, 4. Choroiditis, 5. Conjunctivitis, 6. Cataract, 7. Corneal ulcer, 8. Glaucoma, 9. Styes, 10. Headaches, 11. Ocular hysteria, 12. Iritis, 13. Insomnia, 14. Migrane, 15. Muscular abnormalities, 16. Myopia, 17. Neuralgia, 18. Ocular fatigue, 19. Optic atrophy, 20. Chronic optic neuritis, 21. Ptosis, and 22. Vitreous opacities.

I have no doubt that all these conditions mentioned can and have been very much benefited by diathermy and high-frequency. Let me say, however, I think there are some in this list which an optometrist should not attempt to treat. Also, that some of these conditions have proven not to be so successful in responding to the treatment for me, as others have found them. This I am not blaming on the therapy, because I might possibly have not carried out the technique in its proper way, as others have done. But, to the best of my knowledge and ability I have followed the most successful techniques in the work. And am using the best type of instrument recommended for optometric work.

Let me mention the conditions which I deem within the realm of optometric practice to treat.

Amblyopia exanopsia. Asthenopia. Cataract. Headaches from eye-

strain. Muscular imbalances and insufficiencies. Myopia. Ocular fatigue. These conditions have been treated by me with varying results.

Besides these conditions I have frequently used autocondensation (diathermy) either before or after a routine ocular examination, which most always produces very pleasing immediate effects on the patient. It seems to quiet a nervousness which a patient sometimes manifests upon beginning an examination. It also relaxes those patients who appear to be fatigued from the examination.

Let me mention one reaction that some of the patients get from the autocondensation treatment. Usually in commencing diathermic treatments I most always start the first treatment with the autocondensation pad and rod. Giving about 15 to 30 minutes, using about 500 milliamperes. This is a general systematic treatment. It is primarily a sedative treatment, but gives a stimulative after-effect to the whole body.

After the first treatment and upon the next visit, some of the patients report a disagreeable reaction, manifested by rheumanoid pains in different parts of the body. The majority, however, report very favorable reactions; such as a decided improvement in their general feeling. These cases reporting unfavorable reactions, especially the rheumatic pains, have most every time proven to be more or less toxic upon further investigation. So I am now using autocondensation as a corroborative test in separating patients with uncomfortable eyes, into two groups. Those due to septic absorption, and those due to refractive errors and muscular imbalances which are not caused by toxemia.

The technique for giving diathermic and high-frequency treatments is more or less simple and easy on the patient. They consists of three general types of treatments. Sedative. Stimulative. Counterirritant.

Autocondensation is more practical as a sedative treatment. The patient either sits or lies on a metal flexible pad covered with leatheret or some other fabric. The pad measures about 20 inches by 50 inches and is connected to one of the bi-terminals of the D'Arsonval type current. A metal rod about one inch in diameter and 12 inches long is held by the patient with both hands, and is connected to the other bi-terminal. Enough milliamperes are given to cause the patient to feel a comfortable warmth in both arms; this is all the sensation the patient gets. The usual amount of energy used is from 500 to 800 milliamperes.

There are many accessories used in applying diathermy and high-frequency. Block tin; flexible mesh; metal discs, non-vacuum electrodes and autocondensation pad. Diathermy may be applied direct or indirectly to an area. The direct method generally used is somewhat as follows: A piece of block tin is cut about 2 inches by 6 inches and connected to one of the bi-terminals and is placed against the skin on the back of the neck in the area of the fourth cervical vertebra. This is called the indifferent or inactive electrode. In optometric work the indifferent electrode is most always much larger than the active electrode. This is because we wish to get the heat in and around the eye balls, and the smaller the

active electrode, the nearer to it will the heat be concentrated. The active electrode may also be of a block of tin, or it may be of flexible mesh, metal discs, non-vacuum electrode. It is connected to the other bi-terminal and placed over the closed eyes, making sure of a good contact so there will be no burning of the skin.

The sedative treatment is given by slowly turning on the current, stopping at the place where the ammeter registers around 100 milli-amperes to every square inch of the active electrode used. Then it is turned back slightly. From 20 to 45 minutes is the usual time for a treatment, and at which time it is slowly turned off. The patient should always remain seated for a few minutes after the current has been entirely turned off.

The difference between the sedative and stimulative treatment is that in the latter the current is turned to the tollerance point immeditaely, then turned on and off by the electric switch at short intervals. The amount of energy used is about the same and the time of treatment is about the same as in the sedative treatment.

High-frequency is usually applied with the vacuum electrode but any of the other may be used, and connected with the mono-terminal, Tesla type of current, the electrode used is moved over and around the area needing the treatment. It is a good stimulative as well as a good counterirritant. But, this type of treatment does not heat the deeper tissues. Therefore, it is only good in optometric work for the lid conditions and other skin and surface conditions in the area of the eyes.

Due to the fact that I have carefully selected my cases for diathermic and high-frequency treatment, I do not have an abundance of material to report on at this time. Remember, I am comparatively new to the work, but I will submit briefly what I have done.

Two cataract cases were treated for a long enough time to determine whether it was worth while to complete the treatment course, for such cases to be completely cured.

A man of around seventy years of age whom I have prescribed glasses for many times during the past twelve years developed cataract in both eyes, one more advanced than the other. The most advanced was removed but the results were not successful. The vision in the untouched eye when I started treatments was 20/300. After more than 20 treatments the vision was so little better that the case was dismissed for the time. Three months later they were started again, and after three treatments every other day he had an attack of angina-pectoris which made it necessary to discontinue it for a week or more. The treatments were started again three different times and each time after two or three treatments the attack of angina-pectoria came on, so we thought it best to discontinue the treatments. The case at this time showed so little improvement that we do not think it would have ever been beneficial to any great extent.

A woman of 60 years was referred to me. She was wearing plus 1.50 D.S.O.U. for distance and plus 2.75 D.S.O.U. add for reading. The ophthalmoscope revealed incipient cataracts in both eyes. The retinoscope gave a net finding of plus 1.50 D.S.O.U. and this gave her the best vision we could get. In the right eye it was 50%; the left eye 60%. Treatments were started a few days later and given every other day until twenty were given. The right eye at the end of the twenty treatments was the same as before, 50%; but the left eye which was not treated had dropped from 60% to less than 50%. Three months later she called for a post refraction and vision in the right eye was improved to 60% and the left eye dropped to between 40 and 50% vision. The patient did not feel that the treatments had done enough good for her to continue to make a trip of more than 20 miles every other day for the treatments, and I agreed with her and marked the case dismissed; recorded poor results. In another year I hope to report more progress on cataract cases.

Cases of amblyopia exanopsia have shown much improvement but at the same time they were cases who needed a strong correction and they also wore the red filter almost constantly over the good eye during the course of treatment with the diathermy and high-frequency. So I do not know just how much benefit the electro-therapy was. I will not cite any cases of this condition.

Asthenopia. After seemingly all other means were used with varying results, of handling such conditions; by resorting to diathermic treatments, the results were most always satisfactory for varying lengths of time.

Headaches. In all types of headaches we found diathermic treatments most excellent for temporary relief. However, in some of them the pain would return in an hour or so.

Myopia. I have treated about fifteen cases of myopia with diathermy and high-frequency in addition to other methods of reducing the error. While I have not seen any case increase by the use of diathermy, as the same time, the results were so varying that I do not feel that I can give a report of any value on myopia.

Muscular imbalances and insufficiencies. Those types of muscular imbalances which do not show definite pathologic origin, with the exception of some squints, are treated with most excellent results when it is used in conjunction with other orthoptic treatment. While I do not give diathermic treatments in all cases of imbalances or insufficiencies, my procedure is; to start with the usual indicated orthophoric training, and so long as the case progresses satisfactorily I continue without the diathermy. But if I do not get along so well with our regular training, I start diathermy with the other treatments. In every case there is more or less noticeable improvement and progress in the regular training, and the patient notices more comfort. It most always shortens the course of orthoptic training.

In closing I will give a detailed report on one case of high exophoria with convergence insufficiency. This will illustrate the value of diathermic treatments, in conjunction with the regular ocular prism treatments.

Mrs. B. a school teacher of 25 years. Complains of headache in the forehead, and has had it for weeks at a time. She is doing about six hours close work each day. She gets nauseated at times; gets drowsy during close work; has photophobia, and watering of the eyes. Has indigestion quite often and is very constipated. The pupils are medium small; the pupillary reaction to direct and consentual light is good. Pupillary reaction to accommodation good. The versions are good, but the convergence is very poor. Her previous glasses were: R. E. plus .50 D. C. axis 180 with 3 P. D. base in., L. E. —.25 D. S. with plus .75 D. C. axis 180 with 3 P. D. base in. The V. A. for both eyes with these glasses was 95%. The new refractive correction is: R. E. —.25 with plus .50 axis 15; L. E. plus .75 axis 165. V. A. for both eyes with new correction 100% plus. The distance phoria with old and new glasses registered 16 P. D. of exorphia and no vertical imbalances. All distance ductions were strong. The near phoria with old and new glasses was 23 P. D. exophoria. Near abductions (out) were 21 P. D. to blur, 36 P. D. break, and 35 P. D. to recovery. Near adductions (in) were 16 P. D. to blur; 17 P. D. to break, and 16 P.D. to recovery. A pair of 4 P. D. bases in were included in the correction for near work only. After about two weeks the patient decided to take the orthoptic treatment. At the first visit before giving treatment the distance phoria was 15 P. D. exophoria; and a near 26 P. D. exophoria. The near ductions were: adductions (in) 14 P. D. to blur, 15 P. D. to break, and 14 P. D. to recovery.

Treatment: 5 to 7 minutes stimulative diathermy at 150 milliamperes. Then near base out training. They were given every other day, and the tests before treatment at each visit were as follows:

1. distance 14 P. D. exo. near, 24 P. D. exo.; and adductions—18/15
2. distance 17 P. D. exo. near, 27 P. D. exo.; and adductions—23/19
3. distance 15 P. D. exo. near, 19 P. D. exo.; and adductions—26/20
4. distance 14 P. D. exo. near, 30 P. D. exo.; and adductions—22/20
5. distance 12 P. D. exo. near, 26 P. D. exo.; and adductions—24/19
6. distance 15 P. D. exo. near, 30 P. D. exo.; and adductions—22/17

Beginning with the next visit we decided to give longer time of diathermy and make it more general, so we used the autocondensation sedative for 30 minutes time using about 800 milliamperes of current. The results are as follows:

7. distance 14 P. D. exo. near 26 P. D. exo. and adductions—26/22
8. distance 13 P. D. exo. near 18 P. D. exo. and adductions—26/22
9. distance 15 P. D. exo. near 20 P. D. exo. and adductions—26/24
10. distance 11 P. D. exo. near 20 P. D. exo. and adductions—30/30
11. distance 11 P. D. exo. near 22 P. D. exo. and adductions—30/28
12. distance 10 P. D. exo. near 20 P. D. exo. and adductions—36/32

As we only agreed on twelve treatments in the beginning, and as the patient was perfectly comfortable after the first three or four treatments and remained so, we dismissed the case for three months. Another series of twelve treatments will be given then should we find it necessary. No doubt, this case could have been continued until all the exophoria had disappared and the ductions developed above normal, but since it would require much more time and expense to the patient we deemed it wise not to insist on such. It has been now over two months since I saw the patient and as she was instructed to return immediately if her eyes bothered her and as she promised to do so, I take it the eyes are still doing well.

Other cases of this nature could be cited which show more wonderful results by diathermic and high-frequency treatment in combination with regular treatments, but I have hesitated to give you such. We are too prone to condemn a thing if it does not measure up to the miraculous results which are sometimes claimed by the over enthusiastic user.

You will remember in the beginning, I told you that I considered diathermy and high-frequency only useful to the optometrist, with a few exceptions, as an adjunct in treating those cases which we have heretofore been treating only with prisms and motility apparatus. So my recommendation for diathermy and high-frequency to the optometrist is its value, if any, in handling muscular imballances and insufficiencies.

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A CASE OF TOXIC AMBLYOPIA*

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Case report—Mr. S., age twenty-three, consulted the writer complaining of a sudden dimunition to nine feet finger vision which started four days before his calling at my office. He also had a history of eczema as the result of soldering acid burns. The history further revealed progressive somnolence, weakness, a staggering gait and a loss of weight of almost 25 pounds. There was a slight suggestion of a positive Romberg. The Wasserman reaction was negative. The urine was negative. The teeth revealed pyorrhea alveolaris.

H smoked about 20 cigarettes a day, but denied the use of much alcohol. There was an almost total absence of protein in his diet.

A tentative diagnosis of pellagra was made by the family physician in spite of the claim of the skin eruption being the result of acid burns.

Stereo-Campimeter: The usual central scotoma for colors was not present at the first examination, however. The field for form and colors was constricted concentrically to about eight degrees.

Perimeter: The perimeter findings for form revealed a decided temporal contraction of the right eye, and a very little contraction of the left.

Opthalmoscope: The retinal vessels were normal except a slight suggestion of being rather full. The disks were slightly hyperemic. The media and retinæ were normal. The pupils were slightly dilated. The iris reactions were a little sluggish but reacted directly and consensually.

Refraction: Static retinoscopy revealed about 0.25 minus spheres.

Diagnosis: A tentative diagnosis of toxic amblyopia complicated by pellagra was made.

Treatment: A rigorous anti-pellagra diet was prescribed by the family physician. He was further advised to drink much water, in addition to hot lemonades upon retiring for skin elimination, and a total abstinence of alcohol and tobacco.

Local optometric treatment began the following day, at which time vision had improved to twelve feet finger vision under the pellagra diet and cessation of tobacco and alcohol.

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*Submitted for publication April 15, 1932.

The vision was further improved at this time by inhalation of amyl-nitrite, high frequency and infra red technique to 20/120.

The following day vision was again slightly better. High frequency and infra red technique was continued daily in addition to the other treatment with the exception of amyl nitrite inhalation, which was discontinued after the first treatment.

Five days after treatment started the vision was 20/20 O. U., and a queer freak—a well definite typical central scotoma for red and green was found, which confirms the tentative diagnosis of toxic amblyopia, the form fields now being normal. Vision is now better in a subdued light. "His friends look queer, on account of their pallor, looking more natural by looking to one side of them."

Prognosis: We were encouraged in the belief that full recovery could be expected by total cessation of alcohol and tobacco and continuance of the anti-pellagra diet.

Two weeks later: The above prognosis seems to be justified as the patient now has practically recovered his color sense under rigorous infra red and high frequency treatment, in addition to the medical and dental aid for the pellagra and pyorrhea.

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GRAPHICAL CASE RECORDS*

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Present day case record systems of myologic training are very liable to be confusing even to the initiated. For this reason I have searched around for a type of record that could be taken in at a glance, both by the patient and by the operator. We all know that to digest the material in a myologic record of the old type means to peruse countless columns of figures. Then follows a mental correlation of these items in summary. How tedius. Just compare this with the easily visualized graphs which show everything in its proper value throughout the entire chart. Another factor which we all must realize is the maintenance of the patient's interest. My myologic cases through this medium are all intensely interested in the daily results on the graph—to watch this line rise or that line fall.

The advantage of this system is that it is not necessary to keep multiple columns of figures. At any time in the graph can the entire condition for that day be determined in its numerical equivalent in a few seconds. There is no limit to the number of daily results which we may want to tabulate. These graphical pictures can be made on standard size notebook paper, and all kept in a binder in alphabetical order.

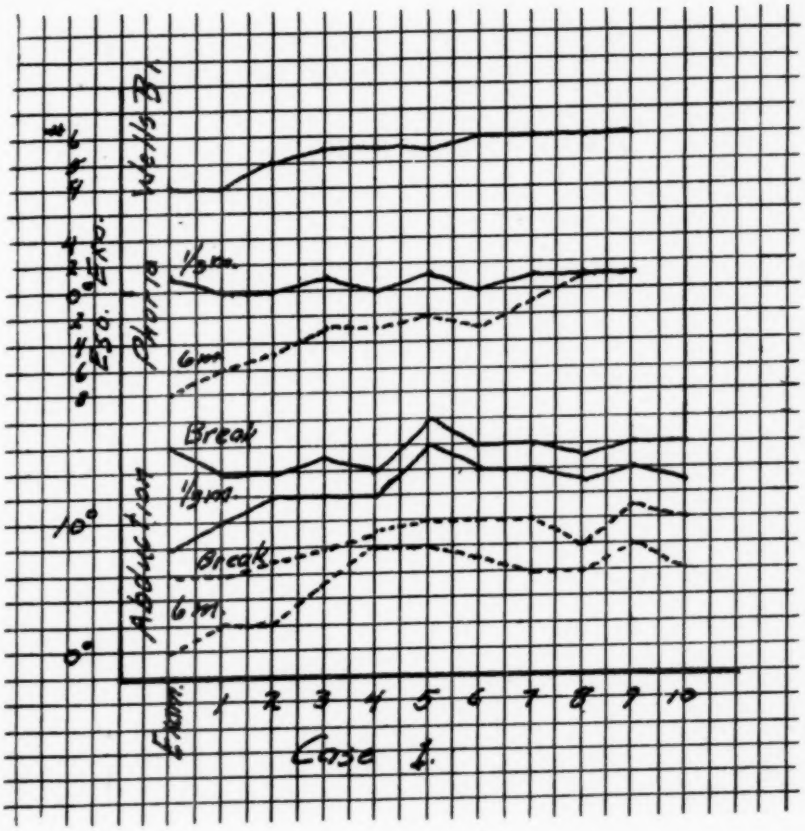
A few little explanations are in order as to my methods of tabulation. Without a doubt others can improve further on this idea, which, in reality, is still comparatively new with me. I use different colored pencils—one for distance tests and another for near tests. You will find a great deal of overlapping, particularly in ductions. The use of colors avoids the possibility of confusion from this factor. A little practice will show how much room to leave for various items. In tabulating the ductions or fusion reserves I have used two lines—one for the break and another for the return to fusion. It is interesting in this way to follow the improvement in "pick-up" as the case progresses. On the absissa I mark only the number of the treatment. This makes the time element easily visible. Dates may be used instead, but it is not necessary when daily treatments are being given. On the ordinate mark the desired tests, such as abduction, uncorrected vision, phorias, etc.

*Submitted for publication March 24, 1932.

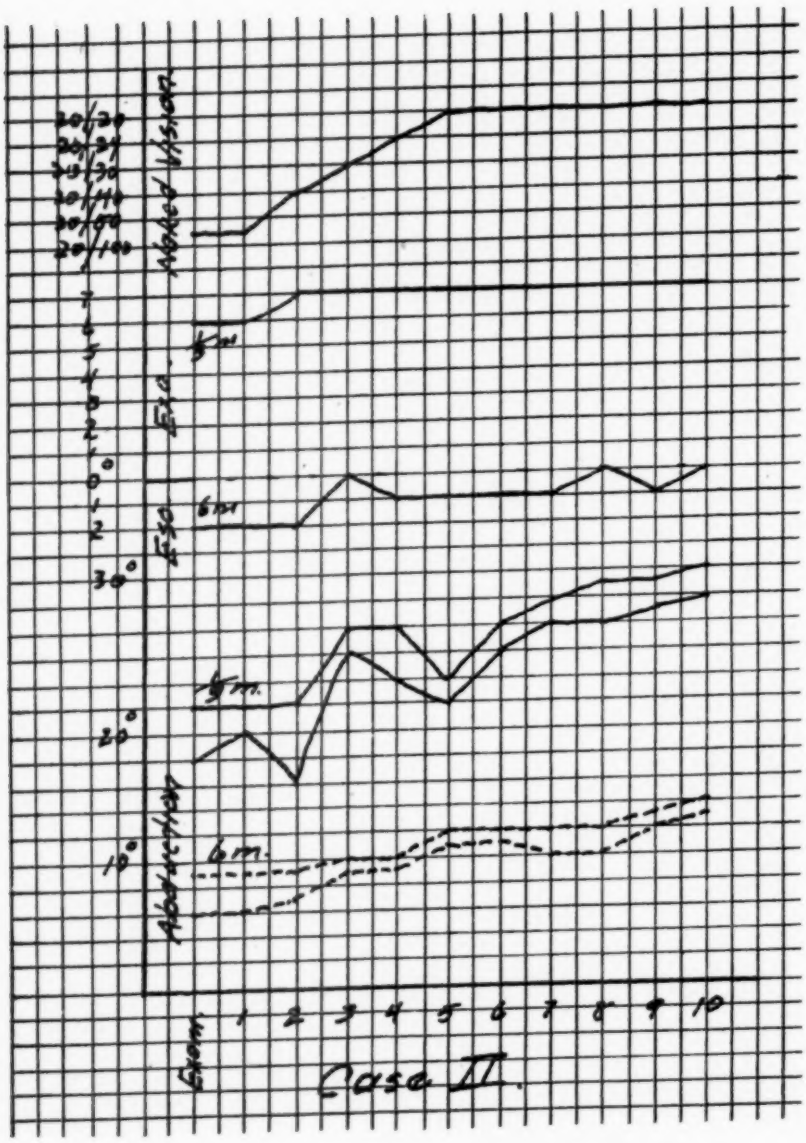
I am using this method at present on all cases of:

1. Duction building
2. Phoria change
3. Reducing amblyopia ex anopsia
4. Reducing functional myopia
5. Progress with Wells or Kratometer treatments
6. Amount of prism used with the Arneson-Peckham system.

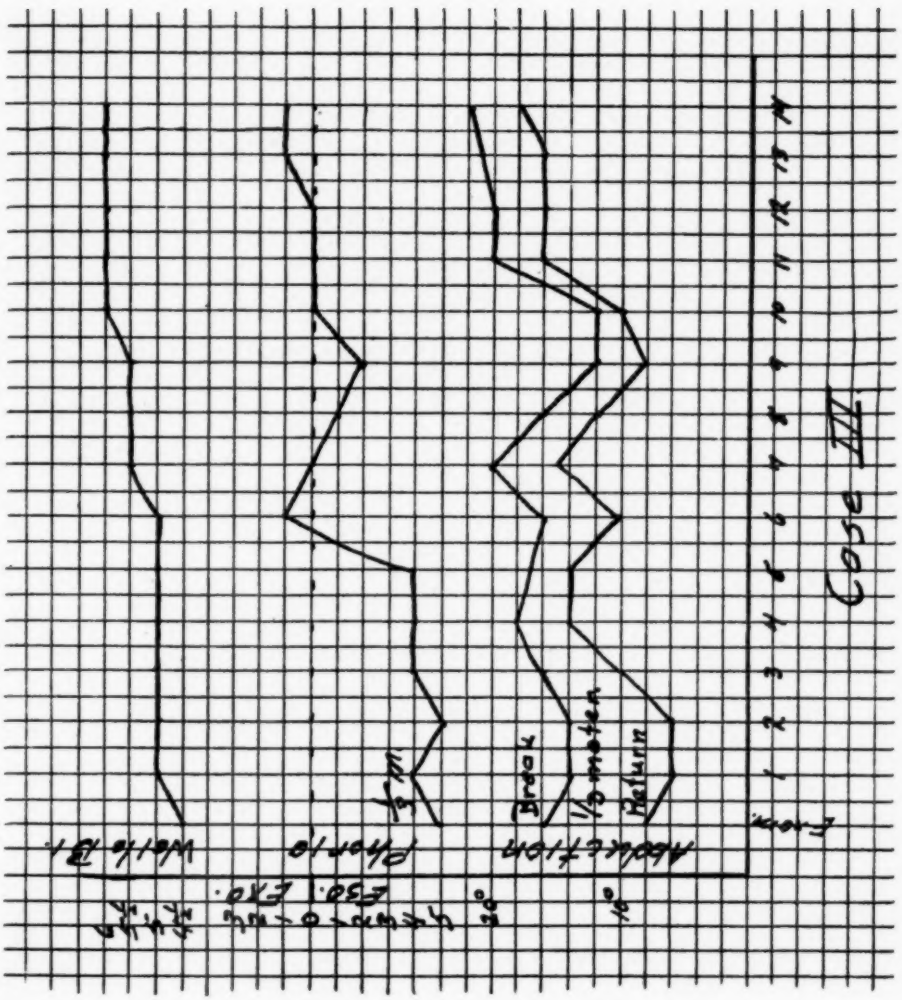
It is readily seen that the use of this charting system is unlimited. It is elastic and may be bent to any desired use. The following charts are from my case records. In these examples I am forced to use broken lines in place of colors.



Case 1—Reduction of Esophoria at 6 meters. Building of Abduction at 6 meters.



Case 2—Reduction of Functional Myopia and improvement of uncorrected vision.



Case 3—Reduction of Esophoria at 13 inches.

I have also found that a prospective myologic case will have more confidence in treatment work if he can be shown records of successful cases like his own. This, last but not least, is one of the great advantages of this method. Few patients want to be an experiment. Proof that results can be had is absolutely necessary to obtain cooperation from the patient.

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THE PUPIL*

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By means of this paper I shall attempt to convey to you some information concerning the pupil in general, and also demonstrate the value of the pupillary reflex tests. This is not an original paper, but merely a collection of data compiled from various books.

The word pupil is derived from the Latin words pupus (boy) and pupa (girl). There is no real connection between the anatomical definition and the above etymology, except that it is believed to refer to the tiny child-like images reflected from the cornea, corresponding to the location of the pupil.

In the fetus, the pupil is closed by a delicate vascular membrane, the membrana pupillaris, which divides the space in which the iris is suspended into two distinct chambers. This membrane is really a portion of the anteror capsule of the lens and is derived from mesodermal tissue. At about the sixth month, the membrane begins to disappear by absorption, from the center towards the circumference. At the same time, the hyaloid artery commences to absorb and at birth only a few fragments are present; in exceptional cases, it persists and is known as congenital atresia of the pupil.

Infrequently, there is seen the rare anomoly called acoria, which is a congenital absence of the pupil. In this condition, there is some interference with the normal development of the eye and the pupillary margins of the iris continue to grow together, leaving no pupil.

The pupils are normally located slightly nasalward in the iris. In cases where the pupil is displaced, the displacement is due either to an operation or is a congenital anomoly. The congenital condition in which the pupil is displaced is known as corectopia.

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*Some weeks ago I assigned to members of the senior class various subjects for collateral reading and had the students prepare theses on the material thus obtained. Some of the work was of such quality that I feel that probably you would be willing to publish several of them in your American Journal of Optometry. The subject matter presents a concensus of modern opinion on the phases dealt with. Please note that the material is not original but rather a collaboration of various authoratative opinions and may be of interest to your readers.—DR. ALBERT E. SLOANE, Department of Pathology. April 15, 1932.

Uncommonly, there are seen cases in which there are more than one pupil present in the eye. When this condition is congenital, it is known as polycoria; in cases due to separation or tear at the ciliary margin of the iris, it is known as iridodialysis.

The size of the pupil is controlled by two opposing muscles in the iris; one, the sphincter pupillæ, is situated in the tissue of the iris near the pupillary margin. It is composed of circular fibres and its nerve supply is the third nerve. The other, the dilator pupillæ, is composed of radiating fibres which have their origin at the root of the iris and their insertion in the sphincter, into which the fibres blend. The nerve supply is the sympathetic. Both these sets of muscles are involuntary in nature.

The pupil is an aperture in the iris and commonly appears as a black spot in the iris. Its two main functions are (1) to regulate the amount of light entering the eye, and (2) to lessen the sperical aberration.

Before attempting to describe the various pupillary reflexes and their significances, I should like to describe the pupillary reflex arc.

When light is flashed into an eye, the impulse travels through the optic nerve to the chiasm, and through the optic tract to the lower visual centers. The pupillary reflex fibres on the nasal side of the retina decussate in the same manner as the other nasal retinal fibres. From the anterior corpora quadrigemina, the fibres pass to the Edinger-Westphal nucleus, a section of the third nerve center. Some of the fibres from the right anterior corpora quadrigemina pass to the right Edinger-Westphal nucleus and others decussate, going to the left Edinger-Westphal nucleus. A similar condition takes place with the fibres passing from the left anterior corpora quadrigemina. From here the fibres pass to the ciliary ganglion, which is situated between the external rectus muscle and the optic nerve, and from the ciliary ganglion the short ciliary nerves pass into the sphincter muscle. From the superior cervical ganglion fibres pass through the ophthalmic division of the fifth nerve and then the long ciliary nerves pass from here into the dilator muscle.

Some authorities claim that there is a connection between the constricting centers and the cerebral cortex, but as no fibres have been definitely traced, existence of these fibres is doubted by many men.

I shall now give you a brief description of the various pupillary reflexes, both normal and abnormal.

Direct Pupillary Reflex. Light if thrown upon the retina of an eye causes the pupil in the eye to contract. If it be absent, no change will occur. If it be diminished, the reaction will be sluggish and incomplete. This test is of value in determining the state of the retina, brain or spinal cord.

Indirect or Consensual Reflex. Light is thrown upon the retina of an eye and the pupil in the opposite eye contracts, thus providing that the pupillary reflex fibres decussate. If the reaction is absent, no change

will occur. If it is diminished, the reaction will be sluggish and incomplete. This test is invaluable in determining the status of the pupillary reflex arc.

Accommodation-Convergence Reflex. The patient looks at distant object and the pupils dilate. Shifting his gaze to a near object, the pupils contract. It is claimed by many men that this reflex is due entirely to accommodation. Others claim that it is due entirely to convergence. Still others claim that it is due to a stimulation of both centers. Most men agree, however, that owing to the sympathetic action between the sphincter ciliaris and the sphincter iridis, the pupil contracts. The above also holds true if this reflex is diminished or absent. This test is employed by many to determine the condition of the nuclear centers for convergence, accommodation, and pupillary constriction.

It is possible for a person to be entirely blind from atrophy of the visual fibres in the retina and optic nerve and still retain normal pupillary action. We may also have normal accommodation with paralyzed pupils, and vice versa.

The pupillary reflexes are of great value in brain cases as the third nerve is located at the base of the brain. Sluggish or immobile pupils result either from adhesions of the iris to the lens, as in iritis, or diseases of the central nervous system.

Platysmal Reflex. The skin of the side of the neck is scratched or pinched. The pupil on the same side of the head will dilate. This reflex is said to be absent in dementia præcox.

Gallassi-Gifford Reflex. The patient's eyelids are held forcibly apart and when an attempt is made to close them, the pupils contract. This is said to be observed in some cases of tabes and paresses.

Wernicke's Hemiopic Pupillary Reaction. This is a test used for determining the location of an injury to the optic tract. (This test is usually applied in cases of hemianopsia.) Throw a beam of light upon the blind half of the retina from the opposite visual field. If the reflex is present, both pupils will contract; if not, no reaction will occur. This reflex determines whether a hemianopia is due to a lesion in front of or behind the geniculate ganglia. If in front, the light reflex of the blind area is absent; if behind, the light reflex is present. The source of difficulty in this test is in stimulating only the blind half of the retina.

Paradoxical Reflex. In this condition the pupil dilates instead of contracting when exposed to a light, and also upon effort of accommodation. This condition is supposed to have no real diagnostic value, but many claim it to be associated with fatigue. Others state that it may be present in tabes dorsalis, pareses, and demential præcox.

Hippus. This is a condition in which there is a periodic contraction and dilation of the pupils due to alternate excitation and inhibition of the iris muscles. This affection is present in disorders affectng the emotions such as mania, hysteria, etc., also in acute retro-bulbar neuritis. In

the pupil there is normally present a slight rhythmic dilatation and contraction due to the filling and emptying of the iridic blood vessels. This must not be confused with hippus, as it is not marked and many times scarcely perceptible.

Argyll-Robertson Pupil or *Reflex Iridoplegia.* This is a condition in which the pupils do not contract to light stimulus, but do contract when accommodation is stimulated. This type of pupil is said be found in 75% of the cases of tabes dorsalis and may also occur in paralytic dementia, multiple sclerosis, and injuries to the spine. Myosis usually accompanies this condition.

The size of the pupils is readily affected by: (a) Light and shade; (b) Sensory stimuli; (3) Drug influence; (d) Emotions; (e) Bodily disease; (f) Sleep, coma, and death; (g) Cerebra spinal nervous states, diseases, etc.

The normal size of the pupil is determined by the tonicity of the radial and circular fibres. In small pupils the sphincter muscle are in control. In large pupils, the dilator muscles are in control. The size also varies in man according to the stimulation of light and the power of accommodation. Normally the pupil size is from 2 mm. to 4 mm. in diameter.

The pupils are contracted in childhood due to the fact that the nervous system is not fully developed, while in youth the pupils are dilated because the sympathetic nervous system is in an unstable condition. In middle life, the pupil attains a more normal size due to the fact that the body and the nervous system are fully developed. In old age the pupils are contracted because of a vascular sclerosis of the capillaries in the iris.

It has been found that the pupils are usually large in myopia and small in hyperopia, due, no doubt, to the habitual relaxation of the accommodation in the former, and its exertion in the latter.

One would suppose that the pupils are dilated during the sleep due to the absence of light, but they are in reality contracted. The supposed reason is, that during sleep, the optic nerve ceases sending impulses and the sphincter, being the stronger of the two muscles in the iris, dominates, causing the pupils to contract.

Just before death occurs, the pupils dilate. After rigor mortis takes place, they contract. When a person is being anesthetized and the anesthesia is pushed too far, extreme dilation takes place. This is often used as a warning sign during anesthesia.

The pupils normally appear to be about ½ mm. larger and nearer to the cornea than they actually are, because the cornea acts as a convex lens producing a larger retinal image.

When the pupils measure 5 mm. or more in diameter, the condition is known as mydriasis. Mydriasis may be caused by the action of certain drugs, by poisons, and by mechanical stimulation.

Mydriatics are drugs which cause mydriasis. The more common ones are cocaine, atropine, homatropine, holecaine, daturin, eucain, and scopolamin. Poisonous doses of various substances such as wood alcohol, ergot, quinine, nitro-glycerine, chloroform, cocaine, etc., will cause mydriasis.

The pupils dilate when the eyes are shaded or when light is removed from the eyes, in stimualtion of the sympathetic nervous system as in pain, laughter, crying, anger, fear, concentration, and exhaustion.

Mydriasis is found in glaucoma (here the pupillary reflexes may be diminished or absent), double optic nerve atrophy, or total blindness from any cause which does not destroy the eyeball, as in embolism of the central retinal artery, a condition in which the pupillary reflexes to light are absent. This widely-dilated pupil is present in epilepsy or convulsion, in paralysis of accommodation (sometimes present following diphtheria), in paralysis of the third nerve from syphilis, in temporary anemia of the brain as in fainting, in palalysis of the brain as in fatal syncope, in brain toumors or abcesses, in diseases of the central nervous system, in exophthalmic goitre, after contusions, and in quinine amblyopia (in which condition, the pupils are fixed and do not react to light).

Pathological mydriasis is either spastic or paralytic. They can be differentiated due to the fact that in spastic mydriasis, the pupils react to light and is due to excessive contraction of the dilators.

When the pupils measure from 1 mm. to 5 mm. or less in diamter, the condition is known as miosis. Miosis may also be caused by the action of certain drugs, by poisons, and by mechanical stimulation, as when the light is thrown into the eye.

Pathological miosis is either spastic or paralytic and may be differentiated in the same manner as pathological mydriasis.

Spastic miosis is the beginning of meningitis, spasms of accommodation, and decrease in intra-ocular pressure due to the aqueous humor escaping from the eye.

Paralytic miosis is an important symptom of paralysis of the cervical sympathetic, spinal lesions, especially tabes dorsalis, and progressive pareses.

Normally, in the majority of people, the pupils are usually round, but are found to be different in certain exceptions. In astigmatism, the pupil is sometimes found to be slightly eliptical, with the long axis usually corresponding to one of the principal meridans of the eye. The normal contour of the pupil is changed by synechia (as in iritis), by coloboma of the iris, iridodialysis, and rupture of the sphincter of the iris. The pupil has also been found to be irregular in contour in certain cases of tabes dorsalis.

Unequal pupils or anisocoria has been found at times to be congenital. In slight amounts it is physiologic, but in marked degree, this condition is usually associated with such diseases as tabes dorsalis,

epilepsy, diseases of the teeth, ruptured sphincter muscle in one eye, in general pareses, cerebral syphilis, and is sometimes associated with tuberculosis. It is frequently present in hemorrhages of the brain with the dilated pupil on the side in which the hemorrhage is present.

By direct gaze, the pupil normally appears as a luminous black aperture in the iris. When the pupil is observed by oblique illumination, it appears to have a luminous black hue in childhood, and adolescence. In middle age, it is a dull black or gray black. In old age, it appears to have a grayish color due to the hardening of the anterior layers of the lens, causing them to become less transparent. In albinoes, there is no pigment present in the eye.

The delicate diaphragm, the iris, which forms the pupil, is readily affected, as has been previously stated in this article, by certain drugs, poisons, by certain disease conditions and by traumatism. By means of the pupil, there can often be detected such profound systematic states as uremia, opium poisoning, belladonna poisoning, and such grave cerebral states as apoplexy, tumors, abcesses, etc., such nervous diseases as pareses, tabes dorsalis, hysteria, etc., as well as such alarming emergency conditions as shock, fatal syncope, sunstroke, epilepsy, poisoning, etc.

Therefore, by noting the size, shape, and equality of the pupils, and the pupillary reflexes (especially the direct, consensual, and accommodation convergence reflexes) much information can be gained by the optometrist in the routine examination.

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OPTOMETRY'S EDUCATIONAL PROBLEM*

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(Continued from 265—July Issue)

The ultimate solution can be no other than that arrived at by the other professions. A preliminary basic course in the college of arts and sciences, mostly common to students of all professions at the beginning, but gradually, in succeeding semesters, driving more and more toward the professional or vocational studies which are carried on in an independent department of the university.

Then if this to be the aim, why not do it at once? is an inquiry we constantly hear. Simply because the optometrists have not taken it upon themselves to make it possible, is the answer.

There is much criticism because the optometry courses are put into the universities under the supervision of an already established department. Every few weeks some one arises to inquire in our journals, why the optometry department in this or that university is not an independent department. There are two reasons. The chief one is that this esteemed optometrist making this inquiry has not dug down in his pocket along with other members of his profession and produced funds to create this separate department. A separate department means the employment of a department head with the necessary academic qualifications and teaching experience. The other reason is that there are few among us of the necessary qualifications to head a department. But such can be found or they can be made, if these questioners will be as liberal with their money as they are with their questions. The entire problem of the independent optometry school on the university campus is one of money and that money ought to come from those who are now practicing optometry since they are the ones to be benefitted by the raising of optometric prestige in the eyes of the public. In other words, contributions to the education of optometrists are a direct financial investment with dividends maturing at an earlier date and in larger percentage than most of the investments into which we permit ourselves to be led.

Then the question is raised as to why the optometry course is put into the physics department. Why not some other place? That

*An abridgement of the material presented before the American Academy of Optometry at Omaha, December 15, 1930.

we counter with another question. Where would you put the course? I think perhaps those who ask this question do not understand the immense fields that modern physics cover. Physiology has come to be but a branch of physics and chemistry, so is medicine. Psychology? The last work on general psychology I read was prefaced by five long chapters on physics. In all universities offering a course in physiological optics, the course is offered in the department of physics. Perhaps that is the reason why the optometry course was dropped in there at first. There is another very practical reason. You will find the professors of physics far more liberal in their attitude toward required subjects or elective subjects than any other group. If you hand this problem to any other department, you will have difficulty in getting a well balanced course. The professor of physics will be far more tolerant of your experiments in developing your courses, for he himself is an experimentalist and knows better than anyone else that a final answer is hard to reach. Our greatest difficulty seems to be in avoiding the mathematical optics professor. Perhaps the logical place is in the department of psychology, but those departments in most universities are relatively new and hardly organized to take on more trouble. Everyone hopes, of course, that optometry's stay in the department of physics will be short, that enough optometrists will see the practical advantages of endowing optometry's education so that the separate department will be possible.

I might insert here that the best description of the layers of the retina in all literature is to be found in a work on "Physical Optics," written by a physicist. (An Introduction to Applied Optics, by L. C. Martin.)

Looking over the field at what we have in the way of schools, we find the following groups:

1. The endowed independent school, 1.

2. Private schools: Class A, 1; Class C, 2. (I think those figures are correct. There may be other under-graduate schools of which I am ignorant. This does not include various private institutions that have lately arisen for the instruction of practicing optometrists.)

3. Universities giving optometry courses: 5 with actual attendance, 1 with no students.

Of the private schools, we must say in fairness that they are eliminating the evils of the old private schools to which reference has been made. But they are still under the handicap of making both ends meet. They are forced to seek quantity without regard to quality, a condition which should be removed by endowment. Last year there was a strong movement started to endow the private school in Portland, Oregon, by subscriptions from the optometrists of the northwestern states. I have not heard whether this was carried to completion.

It is a matter of congratulation that all these schools and univer-

sity courses have a heavier registration this year than ever before. Which is a convincing sign that optometry is not dying out, as so many have gloomily forecast.

It is true that the four year university course has not appealed very strongly to the eastern optometrists. But we note that the university courses in the west have always had more four year students than have the eastern universities. The optometry enrollment in the two western universities is more than double that of the three eastern universities. The enrollment at the University of Southern California is larger than that of the three eastern universities combined. Evidently the westerners are not so reluctant to spend time in preparation as the easterners seem to be.

Examination of the courses offered in the universties shows that as to basic subjects, adequate courses are available, among either the required or elective subjects. But the difficulty is that when the students reach the years in which they take up their professional courses, there is no co-ordination of the earlier subjects. So while the student has had his preparation in biology, physiology and psychology, he is not taught to make use of it in practical application to optometric problems as they are presented to him. That is a teaching problem that must be solved. The reason is that the optometry teachers have not, as a rule, been grounded in those subjects that their students have taken, they are not acquainted with the intimate relation of these subjects to the study of ocular functions. So the student has in his hands a mass of uncorrelated data.

Optometrists in general should know something of the instruction given in their schools. Those who are really interested in the problem and are somewhat grieved over the situation, should make themselves very conversant with the courses given in the leading schools. Only thus can they put themselves in position to act in advisory capacity. And this one thing must be noted, most of the universities have stated through officials in authority that if the optometrists will but tell them what they want taught, it will be taught. There is no doubt but that the university faculties have given this subject far more thought than the optometrists have nor is there any question but that they are anxious to conform to our needs and anxious to know what we think are our needs.

In studying the optometry curricula of the different universities, we can see the efforts that have been made to pragmatize university tradition of requirements for bachelors' degrees with the exigencies of vocational training. Perhaps a large part of this difficulty is due to the number of units in a major subject that the candidate for a degree must cover, with the difficulty of fitting many of the optometric subjects into that major subject. A recent commencement address by a college president contained this statement: "The college does not teach a man how to make a living, that is not its function. It aims to teach him how to study and how to live." Now, we optometrists are asking the

college to divide up that four years and teach our students how to study, how to live and how to make a living. Heretofore, they have left that "How to make a living" to the professional school with its post graduate courses. That the colleges are willing to make the experiment bespeaks their kindliness. But, as the dean of one of the universties said to me: "Here is a group of men begging for education, voluntarily asking us for help, not at the demand of law, but of their own free desire to elevate themselves. We are not going to refuse them." So while we may feel that these courses are not the best that could be evolved, we must remember that this is a new venture. Perhaps some of the universities show a little more definitely than others a selection of courses designed primarily for the development of an optometrist ready to step out into the world and practice his calling, but we may naturally expect revisions and improvements in all colleges as time goes on and experience shows what is best taught and how it is best presented.

Without doubt, the reason that optometry students have not been drawn to the university courses in larger numbers is their feeling that the courses were not designed especially for the preparation of practioners but were too largely concerned in matters of interest only to the optical engineer and the mathematical optician. Young men and women entering optometry today do not care to be called opticians and do not care to be trained as opticians. This probably holds them out of the university more than the extra year or two of study required. In fact, we find many students today in optometry schools who have the bachelor's and, sometimes the master's, degrees. Which means that they are spending, not four years, but six or seven in preparation for life's work.

There is no doubt but that in all the universities this difficulty of subjects will be solved. The head authorities know that the practicing optometrist will have little use for higher mathematics, little use for geometric optics, no use whatever for physical optics. But they meet those of our group who are still beset with the tradition that everything in optics belongs in an optometry course and they acquiesce. Much time is spent now in most of the colleges in these subjects that may well be transferred to subjects for which the new optometrist will have direct use. In one of the universities, a faculty committee were talking over the new optometry curriculum. A great number of courses were suggested, that could not possibly be covered in the four years. So each was taken up in turn, to see if it could or could not be eliminated. Came up the course in psychology. One of the group, evidently under the impression that an optometrist is a hybrid variety of optician, asked: "But why psychology in the optometry course?" Up jumped the president with fist pounding table, "Gentlemen, you may cut out every other course on these lists, but psychology stays in." The same president, when they were discussing who could head the new course, said, "Why, there's no question, we must have a physiologist." A certain logical candidate was suggested—"But he is an optical physi-

cist, we cannot use him." In another university, the same subject was being discussed. There the decision was that a student of visual psychology would be the logical department head. So by these signs, we may gauge what some of our university friends think is the foundation of optometry's future courses.

I remember a statement made a few years ago by one of our optometric teachers in which he said that it was hard to find enough subjects to fill up a two year course. But in talking with others, I find them complaining of the impossibility of finding time in three years or four years for the subjects recognized as imperatively necessary, to say nothing of those that educational experience has shown essential to rounding out a student's mental equipment for his life work.

We must realize that optometry, in the terms of its definition in the statutory laws, is the biggest, the broadest, with the greatest field of practice, the most unlimited possibilities, of any profession that has ever arisen. Those who bemoan "the statutory limitations of optometry" have small vision.

Let us compare the courses at the different universities to see how they are meeting the situation. This comparison is not for the purpose of criticism, but to study the various proposals and learn something of what is being done. We remember that all are in an experimental stage, that all are trying to solve a problem new to education. We take their published curricula as our source of information. Included in this comparative analysis we will show the typical professional school's three year course, as exemplified by the Pennsylvania State College of Optometry. And when we get them all lined up, we shall find to our surprise that some of the criticisms leveled at the universities because of heavy theoretical optics and mathematic courses are unjust, since only one shows more time on these subjects than does the independent school and most of them give less time to these than does the independent school.

As the comparison basis, I have employed the "unit" system as it is used in most universities. In general terms, a "unit" represents one class room period of one hour, for which two hours of preparatory study are needed, or one lecture period of one hour requiring two hours of collateral reading, or a laboratory period of two hours with an hour of outside reading necessary, or a laboratory period of three hours for which no outside work is essential. In its basis, the unit represents three hours of work. Fifteen to sixteen units per week make up the average student's work, that means about forty-five to forty-eight hours per week study and recitation. A student taking seventeen or eighteen units per week is doing heavy work. A one unit course means that there is one class room session or one laboratory period per week for a semester (half year or 18 weeks). A two unit course means two such periods each week of the semester, and so on. In a subject such as biology, requiring six units or eight units per year, three or four periods each week are given to the study in each semester. In the following

list where we show ten units in a subject per year, there would be five units in each semester. In a six unit course, there might be three units in each of the two semesters or there might be two units in one semester and four in the other. The Ohio program is made up of three terms per year in place of two semesters, so I have been forced to schedule this differently from the printed curriculum in order to put the courses on a comparison basis with the others. The Pennsylvania curriculum is printed in hours spent in recitation room or laboratory and as "hours" do not mean much, it has been difficult to properly evaluate some of the courses into "units" for our comparisons. The average requirement for a bachelor's degree in colleges is 126 units, requiring, normally, four years, may be completed by a student of above the average, in three years. The ambitious student may add elective extras up to a total of as much as 140 units, but few students have the physical strength to carry so much work as this in four years.

For the sake of comparative analysis of courses in the various colleges, I have classified the subjects into seven groups, as follows:

Group. 1. Cultural Subjects.

English (Rhetoric).

California:	6 units in first year.
Columbia:	6 units in first year.
Ohio:	8 units in first year.
Rochester:	6 units in first year.
Southern California:	6 units in first year.
Pennsylvania:	Not given.

German or French (choice permitted).

California:	5 units in second year.
Columbia:	14 units in first and second years.
Ohio:	Not listed in Applied Optics Bulletin.
Rochester:	6 or 12 units in first and second years. (See History.)
Southern California:	Elective 6 units in second year.
Pennsylvania:	Not given.

History.

California:	American Institutions, 2 units in third year.
Columbia:	Contemporary Civilization, 10 units in first year.
Ohio:	Not required.
Rochester:	6 units in Modern History may be elected in first or second years in lieu of German or French.
Southern California:	American Constitution, 3 units in first year.
Pennsylvania:	Not given.

Group 2. Sundry Subjects. (Not readily classified in other groups.)

Economics.

(Fundamental business principles.)

California: Not listed in Optometry Bulletin.
Columbia: Elective 6 units in third year.
Ohio: Not listed in Bulletin of Applied Optics.
Rochester: Not listed in Bulletin of Institute of Optics. (A 6 unit course was given to the students who graduated in 1930.)
Southern California: 3 units required in fourth year.
Pennsylvania: Not listed. (Some fundamentals of business practice as applied to professional practice are given in the courses in Office Practice.)

Hygiene and Physical Education.
California: 8 units in first and second years. (Note below.)
Columbia: 5 units in first and second years.
Ohio: 5 units in first and second years.
Rochester: 4 units in first and second years.
Southern California: 4 units in first and second years.
Pennsylvania: Not given.

(Note: California 8 units includes military training compulsory to residents of California receiving free tuition; optional with others. These courses in all colleges consist of one weekly lecture in personal hygiene with several hours gymnasium work.)

Orientation.
Southern California: 1 unit in first year.
Not given in the other schools.

Public Speaking.
Southern California: 2 units in second year.
Not given in the other schools.

Mechanical Drawing.
California: Not required.
Columbia: 2 units in third year.
Ohio: 2 units in first year.
Rochester: 2 units in third year.
Southern California: 2 units in second year.
Pennsylvania: Not given.

Group 3. Basic Science.
Mathematics.
California: 3 units, Analytical Geometry in second year.
Columbia: 11 units total: Trigonometry, first year, 2 units; Solid Geometry, first year, 3 units; Analytical Geometry, second year, 3 units; Calculus, second year, 3 units.
Ohio: 5 units, Elementary Analysis, in second

	year.
Rochester:	6 units, Elementary Functions, in first year.
Southern California:	3 units, Trigonometry, in first year.
Pennsylvania:	10 units total: Advanced Algebra and Trigonometry, 6 units in first year; Analytical Geometry and Calculus, 4 units, in second year.

Physics.

California:	10 units in first, second and third years.
Columbia:	8 units in second year.
Ohio:	5 units in first year.
Rochester:	8 units in first year.
Southern California:	8 units in second year.
Pennsylvania:	8 units in first year.

Inorganic Chemistry.

California:	10 units in first year.
Columbia:	4 units in second year.
Ohio:	10 units in first year.
Rochester:	8 units in first year.
Southern California:	8 units in first year.
Pennsylvania:	Not given.

Group 4. Physiology Foundation.

Biology (Zoology).

California:	Not required.
Columbia:	Elective 5 units in third year.
Ohio:	Not required.
Rochester:	6 units in second year.
Southern California:	8 units in first year.
Pennsylvania:	Not given.

Physiology.

California:	5 units in second year; 2 units elective in third year.
Columbia:	2 units in second year; 2 units elective in third year.
Ohio:	7 units in second year.
Rochester:	3 units in second year.
Southern California:	6 units in second and third years.
Pennsylvania:	3 units in first year.

Human Anatomy.

California:	3 units in third year.
Columbia:	Not listed in Optometry Bulletin.
Ohio:	8 units in first year.
Rochester:	3 units in second year.
Southern California:	3 units in third year.
Pennsylvania:	3 units in first year (taught from cadaver.)

Histology.
- Ohio: 6 units in first year.
- Pennsylvania: 2 units in first year.

Not given in the other schools.
- Ohio: 8 units in second year.
- Pennsylvania: 2 units in first year.

Bacteriology and Pathology.
Not given in the other schools.

Organic and Physiological Chemistry.
- Pennsylvania: First year, 3 hours class and 6 hours laboratory per week in first semester, 2 hours class in second semester; second year, 2 hours class and 3 hours laboratory in first semester. Total 10 units.

Psychology.
- California: 6 units in second year.
- Columbia: 6 units in second year, elective 3 units in third year.
- Ohio: 6 units in second year.
- Rochester: 6 units in second year.
- Southern California: 7 units in second year; 2 units in fourth year. Total 9 units.
- Pennsylvania: 6 units in second year.

Group 5. Optics Foundation.

Theoretic Optics.
- California: Geometric Optics, 3 units in third year. Physical Optics, 3 units in third year. Spectacle Optics, 4 units in third year. Total, 9 units in third year.
- Columbia: Geometric Optics, 12 units in third and fourth years. Physical Optics, 2 units in third year. Spectacle Optics, 3 units in fourth year. Total, 17 units in third and fourth years.
- Ohio: Theoretical Optics, 10 units in third year. (Divisions not specified in Bulletin.)
- Rochester: Geometric Optics, 9 units in second and third years. Physical Optics, 3 units in third year. Spectacle Optics, 2 units in second year. Total, 14 units in second and third years.
- Southern California: Geometric Optics, 3 units in third year. Physical Optics, not advised for Optometrists. Special Course in Theoretic Optics for

Students of Optometry, 4 units in third year, preceding Geometric Optics. Total, 7 units in third year.

Pennsylvania: Physical and Geometric Optics, including Spectacle Optics, 12 units in second third years.

Group 6. Purely Vocational Subjects.

Theory and Practice of Optometry, including Clinical Practice.

California:
6 units class and lectures in third year;
6 units class and lectures in fourth year;
6 units lectures and laboratory in fourth year;
2 units clinical practice in fourth year.
Total, 20 units in third and fourth years.

Columbia:
6 units class and lectures in third year;
6 units class and lectures in fourth year;
8 units laboratory and clinical practice in fourth year.
Total, 20 units in third and fourth years.

Ohio:
8 units class and lectures in third year;
10 units laboratory and clinical practice in fourth year.
Total, 18 units in third and fourth years.

Rochester:
6 units class and lectures in second year;
8 units class and laboratory in third year;
10 units class and laboratory in fourth year;
2 units clinical practice in fourth year.
Total, 22 units in second, third and fourth years.

Southern California:
2 units lectures in second year;
8 units class and laboratory in third year;
1 unit Pro-seminar in fourth year;
9 units clinical practice in fourth year.
Total, 20 units in second, third and fourth years.

Pennsylvania:
1 unit laboratory in first year;
6 units lectures, class and clinic in second year;
18 units lectures, class and clinic in third year.
(Note: See Physiological Optics below. The third year is principally clinical practice. There is given a course in

Office Practice, not given in other schools.)

Physiological Optics.

California: 4 units in fourth year.
Columbia: 5 units in fourth year.
Ohio: 8 units in third year.
Rochester: This subject has been divided into three sections:
(1) Physical and Mathematical;
(2) Anatomical and Physiological;
(3) Psychological; these are each presented in co-ordination in associated courses.
Southern California: 6 units in fourth year.
Pennsylvania: 13 units in first, second and third years. Includes much that is presented in Theoretic Optometry in other schools.

Anatomy and Physiology of the Eye.

California: 2 units in third year.
Columbia: 6 units in third year.
Ohio: 8 units in second year.
Rochester: 2 units in third year.
Southern California: 2 units in third year.
Pennsylvania: 6 units in first and second years.

Ocular Pathology.

California: 2 units in fourth year.
Columbia: 4 units in fourth year.
Ohio: 3 units in fourth year.
Rochester: 6 units in fourth year.
Southern California: 6 units in fourth year.
Pennsylvania: 14 units in second and third years.

Optical Shop Work.

California: 4 units in fourth year.
Columbia: 4 units in fourth year.
Ohio: 4 units in fourth year.
Rochester: 6 units in third year.
Southern California: 9 units in third and fourth years.
Pennsylvania: 9 units in first, second and third years.

Group 7. Electives.

	1st yr.	2nd yr.	3rd yr.	4th yr.
California	3 units	5 units	5 units	7 units
Columbia	.....	.....	6 units	.....
Ohio	.....	5 units	6 units	8 units
Rochester	.....	.....	6 units	12 units
Southern California	.....	6 units	2 units	6 units
Pennsylvania	.....	.....	.....	.....

(To be continued)

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AMERICAN JOURNAL OF OPTOMETRY

VOL. 9 AUGUST, 1932 NO. 8

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Published Monthly by the
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The Journal has no objection to the reprinting by other magazines of any of its articles, provided such reprints are properly credited to the American Journal of Optometry.

EYEDNESS AND HANDEDNESS

Refractionists in general have given little attention to the relationship of eyedness to handedness and the possible effect of one upon the other, especially when the normal relationship is changed. This change which mostly occurs during childhood is sometimes made through the process of education and training and at other times it is the result of force.

Speech abnormalities the result of changed handedness

While refractionists paid little attention to this subject, considerable study and investigation along these lines has been consistently carried on by many educators, psychologists, neurologists and others, and some interesting information is being brought to light. For instance, it is now being claimed that if a normally left handed child is forced to change over to righthandedness speech abnormalities usually develops as a result of this change. Also, other nervous derangements may result.

The question may be raised: of what interest is this subject to the optometrist? This, some may contend, is essentially a problem of the educator. However, upon closer analysis we find that this is really our

problem because in order to determine whether a child is right handed or left handed, it is necessary to first establish whether the right or the left eye is dominant. The dominant eye, claims Parson, establishes the dominancy of handedness. It is not sufficient to merely watch the child and note which hand he uses most readily in his work or play and on that basis judge him to be right or left handed. This method is not very reliable and certainly fails completely in the doubtful cases. It is necessary to have a technique which will enable us to determine with certainty the native handedness. This can be determined with a great degree of accuracy by determining the eye dominance. The correctness of this statement can be proven from an anatomical and physiological standpoint. Parson in this connection offers the following line of evidence contending that it is not unreasonable to suggest: "First, that earliest man, like the highest apes, possessed pure binocular vision. He sighted laterally, with either eye as needed, and was, therefore, like the simians, ambidextrous. Second, that the fixed unilateral sighting faculty, accompanied by handedness, developed with the manufacture and intelligent use of weapons and that in the beginning it was without any marked general bias for either the right or left side. Third, that the biological ascendancy of righteyedness and righthandedness subsequently came about through natural selection as a result of one or more now obscure causes, the most likely being the very obvious advantage that would accrue to the warrior who as he faced his opponent carried his spear or club in his right hand. With the invention of the shield this initial dextroid tendence would of course be intensified. We are thus brought to the conclusion that eyedness, accompanied by handedness, is a fixed characteristic of the race, pure binocular vision accompanied by ambidexterity representing the ancient parent type, and righteyedness accompaned by righthandedness and lefteyedness accompanied by lefthandedness the two subsequent mutations."

Man has a double nervous system, the right brain controls through a decussating nervous system the left side of the body, and the left brain controls the right. Besides this duplicate faculties which characterize all bilatral forms "man has developed certain dominant signle faculties," claims Parson, "such as speech, memory, etc., which can not be classed as belonging to either side of the body exclusively, but these belong rather to the body as a whole. In a general way it can be stated that we find the neural areas which inervate these highly complex single faculties grouped in the same hemosphere that contains the centers controlling handedness and eyedness. This close associative arrangement affords the most direct and speedy coordination of sight impression with intellect, will and action." In order to have harmony of function, righteyedness accompanies righthandedness and lefteyedness accompanies lefthandedness.

This eye and hand relationship has been proven further by a number of examinations carried out by Parson. In these examinations,

he used the manuscope (an instrument he devised to determine the dominant eye) and first determined the native dominant eye. He then checked to see whether the dominant hand was on the same side of the dominant eye. In his investigation he used a group of 877 children. Of that number 608 or 69.3% were found to be right handed; 257 or 29.3% left handed and 12 or 1.3% impartial. Of the 608 right handed children, 604 were found to be right eyed—there was nearly 100% perfect coordination between the visual and manual elements. Out of the 257 left eyed pupils only 32 or only 13% were found to be left handed and 225 were right handed. Here, Parson maintains that the eye tests show the original and not the acquired condition of handedness and that parents, teachers, nurses and others are responsible for the change sinistrality (lefthandedness) into dextrality (righthandedness). From studying the individual history of each child, it was found that most of them were changed from lefthandedness to righthandedness and it is in these cases that our work of being able to determine the dominant eye is of great importance. In some cases it was also found that the change was the result of ocular abnormalities.

Besides these interesting facts brought out in Parsons' studies, there are some other points of importance to us as optometrists. In some of the hypothesis advanced by him, he claims that when we look straight at an object with both eyes the dominant eye looks directly in a *straight* line to the object and that the other eye turns in so as to meet the imaginary straight line between the object and dominant eye. If this be so, we may have to modify considerably our present ideas about binocular vision, adduction, abduction, fusion and the use of prisms in our prescriptions. Practically all of our literature on the subject of ocular muscle balance is based upon the principle of triangualtion in which the base line is formed by a line joining the nodal points of the two eyes and the two sides are formed by the visual line meeting at the object of regard, forming the apex at that point. These two sides form equal angles at the base. The point of fixation then lies on a line drawn as a perpendicular bisecting the base line so that the distance from the nodal points of each eye to any point on the median line are equal. In this case, when we fix our eye on an object in the act of binocular vision we consider that each eye is equally dominant and that both eyes converge so as if the object is located on the median line, perpendicular to the ocular base line. While this ideal arrangement meets our present views of accommodation and convergence, it does not exactly work out so smoothly and harmoniously when eye dominance is concerned. Clinical tests show that when an object is fixed binocularly, it does *not* lie on the median line, but is instead located on a staight line which connects the dominant eye with the object and the visual line of the other eye turns into the object, hence, in binocular single vision we may consider diagramatically to get a right angle triangle.

This subject is of great importance to us and affords a wide and interesting field for clinical study and experimental observation.

J. I. K.

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ANNOTATIONS
AND
SOCIETY PROCEEDINGS

The American Journal of Optometry is the Official Organ of the American Academy of Optometry, as well as the Organ of the Arkansas, Delaware, Indiana, Iowa, Maine, Maryland, Michigan, Minnesota, Nebraska, North Dakota, Oklahoma, Pennsylvania, South Dakota, Vermont and West Virginia Optometric Associations.

The following gentlemen have consented to supply items of interest from their respective sections, acting in the capacity of

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MIS-GUIDED OPTOMETRIC ADVICE

The writer receives from time to time booklets, house-organs and other similar literature from manufacturers of optical material. Some of these pieces of printed matter are, without a doubt, necessary in the conduct of their business yet many of them are, I believe, unquestionably harmful to the very houses which sponsor them. In this latter harmful group are those which fall in the general classification of "Business Builders" for the optometrist. Just why our manufacturers persist in encouraging advertising on the part of optometrists, has always been a mystery to the writer. During the past several years I have noticed that the very optometrists they were encouraging in the use of commercial tactics usually became the leaders in price-cutting in their respective communities. These men are also frequently using inferior material to enable them to carry on the price cutting program into which their display advertising naturally led them. This price-cutting, has effected all other refractionists and wholesalers in these communities, forcing all to reduce prices and handle inferior material made by small irresponsible manufacturers. Thus in the end, proving harmful to the large responsible manufacturers, who have been so prolific in their distribuion of advertising aids and so-called economic advice.

On several occasions also learned (?) economists have been engaged to prepare talks and articles on economic subjects for optometric con-

sumption. Invariably these gentlemen talk to the optometric group as though they were talking to shopkeepers much to the disgust of all true optometrists. As certain optometrists from time to time read this stuff and follow the misguided advice contained therein and are therefore led into commercial channels, it develops that the manufacturers themselves along with all real optometrists suffer as these commercial ideas and the cut price tactics which follow them are in many cases the result of efforts on the part of the manufacturers themselves.

While the writer is convinced that the manufacturers are merely misguided in their efforts, and are not sending out this stuff in an effort to injure the profession, the result is to a great extent the same. Not only could these manufacturers save such money by putting these pseudo economists to work at something worth while and useful but they also would remove from themselves the stigma of handing out poor advice to a group who would be much better off without it. C. C. K.

* * * * *

NORTH DAKOTA OPTOMETRIC ASSOCIATION

The annual Graduate Clinic of the North Dakota Optometric Association will be held at Fargo on August 11th and 12th. Dr. A. M. Skeffington of the Graduate Clinic Foundation will be in charge and optometrists are invited to attend this educational session. The registration fee is $10. Members of the society are arranging to bring to the clinic difficult cases of refractive error or muscular imbalance for use as clinical material.

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NORTHERN ILLINOIS COLLEGE OF OPTOMETRY

The new 32 page catalog of the Northern Illinois College of Optometry has been issued dealing with the 1932-1933 school year. This is a well gotten together review of the school's activities and optometrists wishing a copy should write to the registrar, L. E. Needles, Northern Illinois College of Optometry, 4043-4045 Drexel Blvd., Chicago, Ill.

* * * * *

PARTING OF THE WAYS

It is interesting to read that Julius Berg, attorney for the American Optometric Association, in a recent report to that body deplores the fact that certain optometrists are either so indifferent to, or ignorant of, professional custom as to advertise. As a professional man himself, Berg, no doubt, views this matter as do all other professional and cultured people and it must come to him as a distinct shock that a so-called professional organization, such as the A. O. A., still tolerates within its ranks an advertising optometrist.

Just as long as any advertising at all is tolerated, just so long will "price-advertising" be resorted to by that small minority who still do advertise. In the eyes of the public there is very little difference between the two and the time has now arrived for our large professional body to

take a definite stand on this important matter.

The practice of optometry is a professional vocation requiring academic training and professional skill and any departure from accepted professional procedure should be frowned upon by all other members of the profession and should be sternly dealt with by the A. O. A., and the State Societies which compose it. For fifteen years the A. O. A. has turned its back on this important question, in the fear that it might hurt the feelings of a few individuals who should have had their memberships revoked years ago and the time is now at hand for the new administration to place this important position before every affiliated body for action during the coming year.

As the writer has said before, there is no middle ground in this matter. One is either a professional man or a merchant and as the A. O. A. is admittedly a professional organization it is high time the merchants withdrew. C. C. K.

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THE NEW OPTOMETRY

Dr. T. J. Arneson, optometrist of Minneapolis and developer of the "Arneson Technique of Squint Correction" announces the publication of a book on this subject called *The New Optometry*. This work will contain among other things a large number of case reports on the correction of various squint cases.

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A. O. A. MOTOR DRIVERS COMMISSION

Dr. Edwin H. Silver, optometrist of Washington, D. C., Chairman of the National Advisory Commission on Vision for Motor Drivers, has just published a report of the research work done on this subject during the past five years at the Ohio State University and later at the Iowa State University. The report was published in the *National Safety News*.

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COLUMBIA UNIVERSITY BULLETIN

The 1932-1933 bulletin announcing the Professional Courses in Optometry at Columbia University has been issued. This 32 page catalog outlines the four year optometry course as given by this University. Optometrists wishing a copy should write to the Registrar, Columbia University, Morningside Heights, New York City.

* * * * *

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Dr. J. F. Maxwell, 1140 Medical Arts Building, Omaha, Nebraska, is anxious to secure the following back copies of the American Journal of Optometry: September, 1929; January, 1930; April, June and November, 1931. Dr. Maxwell is willing to pay the regular cost price of these copies. Any one of our readers who can spare all or any of these copies is requested to communicate directly with Dr. Maxwell.

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